

# Notice of Allowability

Application No.

10/652,786

Examiner

Chih-Cheng Glen Kao

Applicant(s)

FU ET AL.

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 1/4/07.
2. ☒ The allowed claim(s) is/are 1-49.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
  - a) ☐ All b) ☐ Some\* c) ☐ None of the:
    1. ☐ Certified copies of the priority documents have been received.
    2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
    3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
  - (a) ☐ including changes required by the Notice of Draftperson's Patent Drawing Review ( PTO-948) attached
    - i) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_.
  - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_.Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date \_\_\_\_\_
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date \_\_\_\_\_
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_

### REASONS FOR ALLOWANCE

1. Claims 1-49 are allowed. The following is an examiner's statement of reasons for allowance.

2. Regarding claim 1, prior art fails to disclose or fairly suggest a method, including determining the value of in-plane transformation parameters  $(x, y, \theta)$  and out-of-plane rotational parameters  $(r, \phi)$  for registering a reconstructed image onto an x-ray image, said in-plane and out-of-plane parameters representing a difference in the position of a target as shown in said x-ray image as compared to the position of the target as shown by said image reconstructed from 3D scan data, obtaining an initial estimate for said in-plane transformation parameters  $(x, y, \theta)$  by multi-level matching in 3D (three dimensions), between said x-ray image and said reconstructed image, based on said in-plane transformation parameters  $(x, y, \theta)$  estimated in step a, performing an initial search in one dimension (1D) for each pair of out-of-plane rotation parameters  $(r, \phi)$ , and iteratively refining said in-plane transformation parameters  $(x, y, \theta)$  and said out-of-plane rotational parameters  $(r, \phi)$ , until said in-plane and out-of-plane parameters converge to a desired accuracy, in combination with all the limitations in the claim. Claims 2-20 are allowed by virtue of their dependency.

3. Regarding claim 21, prior art fails to disclose or fairly suggest a system for registering at least one 2D radiographic image of a target with at least one image reconstructed from previously generated 3D scan data of said target, including a controller including software for determining a set of in-plane transformation parameters  $(x, y, \theta)$  and out-of-plane rotational

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parameters  $(r, \phi)$ , said in-plane and out-of-plane parameters representing a difference in the position of the target as shown in said radiographic image as compared to the position of the target as shown by a 2D reconstructed image, wherein said software comprises means for performing a 3D multi-level matching to determine an initial estimate for said in-plane transformation parameters  $(x, y, \theta)$ , in combination with all the limitations in the claim. Claims 22-37 are allowed by virtue of their dependency.

4. Regarding claim 38, prior art fails to disclose or fairly suggest a method, including determining a difference between a present orientation of a target volume and a previous orientation of the target volume in three translational coordinates and three rotational coordinates by comparing in-plane transformation parameters and out-of-plane rotation parameters of x-ray images and synthetic x-ray reference images in a first image plane and a second image plane, wherein determining said difference comprises searching the in-plane transformation parameters in the first image plane and the second image plane using a first similarity measure between the x-ray images and the synthetic x-ray reference images in a 3-dimensional multi-level search, in combination with all the limitations in the claim. Claims 39-43 are allowed by virtue of their dependency.

5. Regarding claim 44, prior art fails to disclose or fairly suggest a system, including a controller coupled with a radiation source, imaging system, and a 3D scan data generator, the controller configured to determine a difference between a present orientation of a target volume and a previous orientation of the target volume in three translational coordinates and three

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rotational coordinates by comparing in-plane transformation parameters and out-of-plane rotation parameters of 2D radiographic images and reconstructed 2D reference images in a first image plane and a second image plane, wherein to determine said difference the controller is configured to search the in-plane transformation parameters in the first image plane and the second image plane using a first similarity measure between the 2D radiographic images and the reconstructed 2D reference images in a 3-dimensional multi-level search, in combination with all the limitations in the claim. Claims 45-49 are allowed by virtue of their dependency.

6. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### *Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chih-Cheng Glen Kao whose telephone number is (571) 272-2492. The examiner can normally be reached on M - F (9 am to 5 pm).


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ed Glick can be reached on (571) 272-2490. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.



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**SUPERVISORY PATENT EXAMINER**